FINAL
ENVIRONMENTAL ASSESSMENT

ISSUANCE OF SCIENTIFIC RESEARCH PERMIT #1303 TO THE NATIONAL MARINE FISHERIES SERVICE - HONOLULU LABORATORY

January 2002

Lead Agency: National Marine Fisheries Service - Office of Protected Resources

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The National Marine Fisheries Service, Office of Protected Resources proposes to issue a scientific research permit to the National Marine Fisheries Service - Honolulu Laboratory. If issued, the permit would authorize the Honolulu laboratory to conduct experiments on methods for reducing sea turtle take by longline fisheries in the Pacific Ocean and to allow import of living, deeply hooked sea turtles for treatment and rehabilitation. The permit would authorize these activities for three years beginning in January 2002.

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Summary

National Environmental Policy Act
The National Environmental Policy Act (NEPA) is our basic national charter for protection of the environment. NEPA procedures ensure that environmental information is available to the public and decision makers before decisions are made and before actions are taken. The NEPA process is intended to help public official make decisions that are based on understanding of environmental consequences and take actions that protect, restore, and enhance the environment.

As part of the NEPA process, an environmental analysis must be undertaken to determine whether the action in question will have a significant impact on the human environment and whether an Environmental Impact Statement (EIS) will be required.

Permits issued under Section 10(a)(1)(A) of the Endangered Species Act (ESA) and their modifications are, in general, categorically excluded from the requirement to prepare an Environmental Assessment (EA) or EIS (NOAA Administrative Order 216-6 Environmental Review Procedures) since, as a class, they do not have a significant effect on the human environment. In determining whether the effects are significant, certain factors relevant to the proposed activities were considered: (1) The degree to which the effects on the quality of the human environment are likely to be highly controversial, (2) the degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks, (3) the degree to which the action establishes a precedent for future actions with significant effects or represents a decision in principle about future consideration, (4) individually insignificant but cumulatively significant impacts, and (5) the degree to which ESA-listed species or their habitat are adversely affected. However, where a proposed action is new, under extraordinary circumstances in which normally excluded actions may have significant environmental impacts, or the potential impacts are controversial, an EA or EIS is required. Consequently, due to the unusual and controversial nature of this research proposal, NMFS has chosen to prepare this EA to evaluate the need for an EIS, as well as to assist the agency in planning and decision making regarding the final decision to issue a scientific research permit pursuant to Section 10(a)(1)(A) of the ESA.

Section 10 Permits and the Endangered Species Act
Under section 10(a)(1)(A) of the ESA, individuals and organizations may apply for permits from the National Marine Fisheries Service (NMFS) to take ESA-listed species under the jurisdiction of NMFS if such taking is for scientific purposes or to enhance the propagation or survival of the affected species.

History of the Recent Litigation, EIS Development, Section 7 Consultation, Permit Application.
This permit action falls under the umbrella of a larger action undertaken by NMFS in 1999. NMFS developed an EIS for the implementation of the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region (PFMP). The FEIS was completed on March 30, 2001.

This action has litigation associated with it. A complete history of the recent litigation and EIS development can be found in Section 1.2 of the FEIS entitled "Need for the Proposed Action" (NMFS, 2001a). Copies of the EIS are available from the Southwest Regional Office website (http://swr.nmfs.noaa.gov/piao/eisdocs.htm) or by contacting:

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Section 7(a)(2) of the ESA (16 U.S.C. § 1531 et seq.) requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a federal agency may affect a protected species, that agency is required to consult with either the NMFS or the U.S. Fish and Wildlife Service, depending upon the protected species that may be affected. A complete consultation history for previous consultations under the Pelagics FMP can be found in the November 3, 1998, biological opinion on the reinitiated consultation for the Pelagics FMP Hawai'i North Central Pacific Longline Fishery (NMFS, 1998). That opinion found that the proposed action was not likely to jeopardize the continued existence of listed sea turtles or Hawaiian monk seals, and established anticipated incidental take levels for sea turtles captured by the Hawai'i-based longline fishery. The opinion also required continuation of the observer program for the fishery, handling procedures for incidentally captured sea turtles and review of the circumstances surrounding the observed capture of any leatherback turtle. In a May 18, 2000, memo to the Director of the NMFS Pacific Islands Area Office (PIAO), the Southwest Fisheries Science Center (SWFSC), which is responsible for calculating the estimates of incidental take occurring in the Hawai'i-based longline fishery, it was indicated that the Hawai'i-based longline fishery had likely exceeded anticipated incidental take levels of olive ridley turtles (NMFS, 2000a). On June 7, 2000, the Southwest Region reinitiated consultation on the fishery (NMFS 2000b). NMFS issued its Biological Opinion on the reinitiation on March 29, 2001 on the Authorization of Pelagic Fisheries under the PFMP.

On December 12, 2001, the NMFS Acting Regional Administrator, Southwest Region, Rodney McInnis, signed a memorandum to Donald Knowles, the Director of the NMFS Office of Protected Resources, reinitiating consultation on the effects of the Western Pelagic Fisheries on sea turtles under section 7(b) of the Endangered Species Act, 16 U.S.C. ' 1536(b). NMFS reinitiated the March 29, 2001, consultation because new information is available which may improve NMFS' ability to quantify and evaluate the effects of the pelagic fisheries under the Fishery Management Plan (FMP) for the Pelagic Fisheries of the Western Pacific Region and the reasonable and prudent alternative in the Biological Opinion on listed sea turtle populations. The new information available consists of an improved sex- and age- class structured stochastic simulation model of leatherback sea turtle population dynamics, recent eastern Pacific leatherback population censuses for the 2000/2001 season, fewer vessels are operating than what

was anticipated under the March 29, 2001 Reasonable and Prudent Alternative, new observer data collected since 1999, and correction of a minor error to the anticipated take in the incidental take statement. If the evaluation of this new information and conclusions drawn as a result of this reinitiation of the March 29, 2001, biological opinion constitute significant new information that would change the evaluation and conclusions of the opinion issued for research permit #1301, NMFS will reinitiate this biological opinion and conduct further NEPA analysis if appropriate.

Under regulations promulgated for Section 7(a)(2), NMFS-OPR can include "conservation recommendations" in biological opinions. "Conservation recommendations" are defined at 50 CFR 402.02 as:

> ".. suggestions of the Service regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information."

In its March 29, 2001, opinion, NMFS-OPR included the following conservation recommendation:

> "NMFS should research modifications to existing gear that (1) reduce the likelihood of gear interactions and (2) dramatically reduce the immediate and/or delayed mortality rates of captured turtles (e.g., visual or acoustic cues, dyed bait, hook type). All research funded and/or implemented by NMFS must be covered by a research and enhancement permit pursuant to section 10(a)(1)(a) of the ESA. The goal of any research should be to develop a technology or method, via a robust experimental assessment, which would achieve the above two goals and remain economically and technically feasible for fishermen to implement."

Several industry/academia/government workshops were held to address possible gear and or fishing tactic modifications with potential to reduce sea turtle interactions with pelagic longline gear (Williams et al., 1996; Kleiber and Boggs, 2000; Anon., 2000; Anon., 2001a; Anon., 2001b; Watson, 2001a). Pelagic longline observer data were analyzed to examine gear, environmental, and operating practices associated with sea turtle longline interactions (Kleiber, 1998; McCracken, 2000; Cramer and Adams, 2000; Hoey, 1998, 2000; Hoey and Moore, 1999; and Yeung, 2001). Data and information and recommendations from these reports are the basis for planned research to develop and evaluate longline gear modifications to reduce interactions with listed sea turtles.

The goal of this proposed research is to develop methods to reduce turtle take and retain viable fishing performance that may be adopted by the U.S. pelagic longline fleet as an alternative to more restrictive sea turtle protection measures, such as closures. The technologies developed through this research are expected to be transferrable to other nations' fleets as well, so this work will address the larger problem of sea turtle bycatch by pelagic longlines throughout the entire Pacific Ocean and in other regions where sea turtle bycatch is a concern. The researchers

believe that the proposed work directly addresses one of the most pressing conservation research question facing sea turtles worldwide.

On May 1, 2001, NMFS' Office of Protected Resources (NMFS-OPR) received a complete application for a scientific research permit from Dr. R. Michael Laurs, NMFS-Southwest Fisheries Science Center - Honolulu Laboratory (NMFS-Honolulu). After making a preliminary determination that the application was complete and in compliance with section 10(a)(1)(A) issuance criteria, and as required by CFR 222.24 (a), NMFS published a notice of receipt in the Federal Register on May 10, 2001, (66 FR 23882). The 30-day public comment period closed on June 11, 2001.

During the development of the application and permit materials, it was determined by NMFS-OPR that a supplemental EA was necessary to assess the impacts of issuing a scientific research permit for the take of turtles associated with the research being conducted in Hawai'i-based longline fishery.

1.00 Purpose of and Need for Action

The purpose of this environmental assessment (EA) is to evaluate the potential environmental effects as a consequence of the NMFS-OPR action of issuing a permit (#1303) to NMFS-SWFSC-Honolulu Laboratory for an annual take of ESA-listed sea turtles under the jurisdiction of NMFS associated with the proposed research activities.

1.1 Need for the Proposed Action - The issuance of this permit is needed to address a priority one recovery goal cited in the Final Recovery Plans for the U.S. Pacific Populations of the Loggerhead, Leatherback, Olive Ridley and Green turtles issued by NMFS and the US Fish and Wildlife Service (FWS). NMFS and FWS specifically identify the monitoring and reduction of incidental mortality in commercial fisheries as a recovery action needed for all four species proposed to be taken if the permit is issued.

In a November 23, 1999 injunction, the Court stated that ...NMFS "conduct research into gear modification that would reduce incidental take."

In the March 29, 2001, opinion, NMFS identified Conservation Recommendations that NMFS can adopt to benefit the species by minimizing or avoiding adverse impacts of a proposed action, help implement recovery plans or develop additional information on the species. Conservation recommendation #1 specifically identified research to reduce or prevent turtle interactions with longline fishing gear.

> "NMFS should research modifications to existing gear that (1) reduce the likelihood of gear interactions and (2) dramatically reduce the immediate and/or delayed mortality rates of captured turtles (e.g., visual or acoustic cues, dyed bait, hook type). All research funded and/or implemented by NMFS must be covered by a research and enhancement permit pursuant to section 10(a)(1)(a) of the ESA. The goal of any research should be to develop a technology or method, via a robust experimental assessment, which would achieve the above two goals and remain economically and technically feasible for fishermen to implement."

1.2 Objectives of the Proposed Action - The objective of the permit is to conduct research that will lead to a reduction in the number of sea turtles incidentally caught in the U.S. pelagic longline fishery in the Pacific ocean, and potentially in longline fisheries throughout the Pacific ocean that incidentally capture endangered and threatened sea turtles.

1.3 Related EISs/EAs that Influence the Scope of this EA - This EA was proceeded by an Environmental Impact Statement developed for the implementation of the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Ocean. The FEIS was completed on March 31, 2001. This permit, if issued, would take place with the boundaries of the Hawai'i-based longline fishery evaluated in that FEIS.

1.4 Relevant Federal, State, and Local government, and Public Involvement - The permit request underwent a 30-day public comment period following notification of receipt in

the Federal Register. The application was also submitted to research professionals, University professors, and NMFS staff with expertise in endangered and threatened sea turtles.

1.5 Decision that Must be Made - The decision that must be made by NMFS-OPR is whether to issue the permit, and if the permit issued, whether to issue it as requested in the application materials.

1.6 Alternative design, evaluation, and selection criteria - The alternatives were developed by reviewing the permit application, March 2001 FEIS, March 2001 Biological Opinion, Final Recovery plans for Pacific populations of green, loggerhead, leatherback and olive ridley sea turtles. The preferred alternative should meet five selection criteria:

- 1.6.1 Respond to Conservation Recommendation #1 from the March 29, 2001 Biological opinion;
- 1.6.2 Responds to the Court's November 23, 1999 injunction that called for NMFS to conduct research into gear modification that would reduce incidental take;
- 1.6.3 Responds to the Priority 1 Recovery Goal calling for monitoring and reduction of incidental take in commercial fisheries for all four species of turtles covered by the proposed permit;
- 1.6.4 Must meet all Section 10(a)(1)(A) issuance criteria, and;
- 1.6.5 Must not result in a jeopardy finding under Section 7(a)(2) of the ESA.

1.7 Issuance criteria- NMFS can deny the permit if it does not meet the issuance criteria spelled out in the implementing regulations for permits issued under section 10(a)(1)(A) of the ESA. There are twelve criteria an application must meet before a permit can be issued for the proposed research. All of the criteria must be met. These criteria are:

- 1.7.1 Whether the permit was applied for in good faith;
- 1.7.2 Whether the permit, if granted and exercised, will not operate to the disadvantage of the listed species;
- 1.7.3 Whether the permit would be consistent with the purposes and policy set forth in section 2 of the Act;
- 1.7.4 Whether the permit would further a bona fide and necessary scientific purpose or enhance the propagation or survival of the species; taking in to account the benefits anticipated to be derived on behalf of the endangered species;
- 1.7.5 Review the status of the population of the requested species and the effect of the proposed action on the population, both direct and indirect;
- 1.7.6 Whether the applicant's qualifications for the proper care and maintenance of the species and the adequacy of the applicant's facilities, if a live animal is to be taken, transported, or held in captivity;
- 1.7.7 Whether alternative non-endangered species or population stocks can and should be used;

1.7.8 Whether the animal was born in captivity or was (or will be) taken from the wild;
1.7.9 Provision for disposition of the species if and when the applicant's project or program terminates;
1.7.10 How the applicant's needs, program, and facilities compare and relate to proposed and ongoing projects and programs;
1.7.11 Whether the expertise, facilities, or other resources available to the applicant appear adequate to successfully accomplish the objectives stated in the application, and;
1.7.12 Opinions and views of scientists or other persons or organizations knowledgeable about the species which is the subject of the application or of other matters germane to the application.

2.0 Alternatives Including the Proposed Action

The proposed action and four alternatives considered in this EA are: (1) take no action (i.e. no permit issued); (2) issue the permit with conditions as requested in the permit application (proposed action); (3) permit based on a high confidence sampling for the minor gear modification (test use of blue-dyed bait and moving branch line); (4) issue the permit based on a one-year design; and (5) issue the permit without the stealth gear and deep-set daytime fishing CPUE. The following summary describes major aspects of the proposed action and alternatives.

2.1 Description of Alternative 1 - No Action (No Permit Issued)

Under this alternative, NMFS-OPR would not issue the scientific research permit to NMFS-SWFSC and the proposed research on turtle/fishery interaction would not be conducted and NMFS would not be able to obtain the data regarding differing gear configurations and turtle interactions. Due to the Reasonable and Prudent Alternatives listed in the March 29, 2001 opinion, the National Marine Fisheries Service - Office of Sustainable Fisheries (NMFS-SF) closed the fishing area north of the equator to swordfish style longline fishing to protect endangered leatherback, endangered and threatened green and threatened loggerhead turtles. NMFS-SF prepared an emergency rule closing this area on June 12, 2001 (66 FR 31561) and effective through December 10, 2001. NMFS extended the closure through June 8, 2002 (66 FR 63630, December 10, 2001). This alternative does not reach the objective of the proposed action: "to conduct research that will lead to a reduction in the number of sea turtles incidentally caught in the U.S. pelagic longline fishery in the Pacific ocean, and potentially in longline fisheries throughout the Pacific ocean that incidentally capture endangered and threatened sea turtles." The No-action alternative does not respond to Conservation Measure #1 placed in the March 29, 2001, opinion, or to the #1 priority recovery goal found in the final recovery plans for all four species of turtle covered by the permit.

2.2 Description of Alternative 2 (Proposed Action) - Issuance of the permit as requested by the applicant

The National Marine Fisheries Service's Office of Protected Resources proposes to issue a scientific research permit (#1303) under Section 10(a)(1)(A) of the ESA to the Southwest Fisheries Science Center, Honolulu, Hawaii, to: (1) take sea turtles while conducting experiments on fishing gear modifications for reducing sea turtle take by longline fisheries; (2) take sea turtles while conducting experiments to test the viability of fishing gear modifications for catching targeted fish species; and (3) import live, deeply hooked, hard-shelled sea turtles for treatment to alleviate hooking damage and to monitor the progression of ingested hooks. The goal of the first part of the experiment is to test modifications to fishing gear that evidence suggests should reduce sea turtle take by longliners, and which evidence also suggests will maintain viable fishing performance. The goal of the second part of the experiment (2) is to see if more radical gear modifications have viable fishing performance, without which there is no point in exposing turtle populations to further testing of those modifications. The ultimate purpose of both parts (1 and 2) is that (a) such measures can be used as an alternative to more restrictive sea turtle protection measures for the domestic longline fishery, such as time and area closures, and (b) foreign longline fisheries worldwide can be encouraged to adopt these fishing methods. Gear modification measures are believed to be the most easily and consistently adopted measures throughout the domestic and international longline fleets and therefore are expected to achieve the greatest conservation benefit for sea turtles. The research is in response to a Conservation Recommendation placed on NMFS in the March 29, 2001, biological opinion for the Pelagics FMP (NMFS, 2001). This research furthers NMFS' compliance with ESA section 7(a)(1) to utilize their authorities in furtherance of the pruposes of the ESA by carrying out programs for the conservation of endangered and threatened species.

The following description of the proposed research is taken from the May 1, 2001, permit application.

All research activity under this permit will be conducted by fishery biologists, biological technicians, fishery observers, vessel operators and crew of Hawaii-based longline fishing vessels. Fishery observers working for the National Marine Fisheries Service (NMFS) Pacific Islands Area Office (PIAO) will supervise most of the experiments which will be conducted on contracted fishing vessels. The principal investigator and principal field supervisor may also recruit fishery technicians to supervise some of the experiments. No experiments will be conducted by vessel operators without supervision by a NMFS employee or contracted fishery biologist, biological technician, or fishery observer.

Under the scientific research permit, fishing vessel operators will be contracted to use their fishing vessels to conduct the fishing experiment under the direction of field supervisors. Catch of target species will be sold to reduce the cost of the contracted fishing operations. In addition, catch sales data will be used to demonstrate the relative economic viability of modified fishing operations in comparison with unmodified fishing operations. Vessel operators will be chosen through an interview process conducted by NMFS that will focus on aptitude, adherence to rules,

understanding of technical requirements, and motivation. Vessel operators under consideration will participate in a workshop covering the fishing technology and contract requirements of the experiments and will be tested on their comprehension to ensure understanding of the experiment, the terms and conditions of their contracts, and the role of their field supervisor. Field supervisors working for NMFS (fishery biologists, biological technicians, or fishery observers trained in turtle handling procedures) will oversee all turtle takes by each fishing vessel and terminate participation by any vessel operator or crew member who does not adhere to research protocols and turtle handling procedures. Furthermore, all measures that have been implemented by regulations in the commercial fishery to reduce the mortality of the bycatch will be used in the experiments (CFR §223.206(d)(1)), including the handling and release of turtles captured, resuscitation, etc. In addition, takes of sea turtles in the experiments will be reported to NMFS on a real-time basis using single sideband radio or the satellite vessel monitoring system. If at any time NMFS determines that the take levels for the experiment have been exceeded or are likely to be exceeded in the control and treatment fishing operations required by the experimental design, then NMFS will cease the experiment.

Vessels contracted for this experiment will fish in typical fishing areas and will strictly adhere to the general parameters presented in Table 1 for experiments with swordfish-style and tuna-style of fishing, respectively. As explained further below, the only experiment that is planned for both styles of fishing is the testing of stealth fishing gear for the viability of target species catch per unit effort (CPUE). Experiments will be conducted throughout the year, depending on the availability of contracted vessels. Tuna style fishing may occur during April and May, but will avoid the closed area established to protect sea turtles (50 CFR 660.34(c)).

If issued as requested in the application materials, the permit would authorize the taking (non-lethal and lethal) of endangered and threatened sea turtles in the Pacific ocean. Table #2 presents the proposed authorized take over the three-year life of the permit.

Table 1. Average of fishing gear parameters for the Hawaii-based longline fishery using two styles of fishing: Swordfish-style fishing and tuna-style fishing.

Gear/Trip Type	Swordfish Fishing	Tuna Fishing
Area Fished	North of Hawaiian Islands	South of Hawaiian Islands
Main line Length	42 miles	34 miles
Shooter Used	No	Yes
Vessel Speed	7.8 knots	6.8
Lightsticks Used	Yes	No
Branch Line Length	17 meters	13 meters
Float Line Length	8 meters	22 meters
Number of Hooks per Set	820 hooks	1,690 hooks
Number of Hooks per Float	4 hooks	27 hooks
Number of Floats	189 floats	66 floats
Type of Hook	J-shaped	Tuna
Type of Bait	Squid	Saury
Target Depth	28 meters	167 meters
Gear Soaks	Night	Day
Soak Time	20 hours	19 hours

Table #2 - Total Turtles Authorized over 3-year life of permit.

Species	Total Take of Turtles	Lethal Take of Turtles
Green	15	6
Leatherback	44	15
Loggerhead	233	87
Olive Ridley	24	9
Total	311	117

The permit would authorize NMFS-Honolulu to capture sea turtles using longline gear to determine methods to reduce the lethal and non-lethal take of turtles in the commercial Hawai'i-based longline fishery. The permit would authorize NMFS' researchers, operating

aboard commercial longline vessels to capture, handle, measure, photograph, collect skin biopsies, flipper, PIT, radio/sonic and/or satellite tag and release turtles incidentally captured in the longline fishery. Turtles that have been deeply hooked and are small enough to be brought onboard the vessel would be brought back to Hawai'i for medical care and rehabilitation if the turtle is captured when the vessel is within 72 hours of returning to port (Table #3). Turtles brought back to port would be given medical care by a veterinarian trained in rehabilitating marine turtles. After rehabilitation, the turtles would be returned to the wild within a 72 hour radius of Honolulu. These turtles would be flipper & PIT tagged, have skin biopsies collected from them and have a satellite transmitter attached to them for long-term monitoring.

Table #3 - Deeply Hooked turtles returned to Honolulu for rehabilitation

Species	Annual Estimated Turtles Transported to Honolulu for Rehabilitation
Green	3
Loggerhead	12
Olive ridley	12

After evaluating the different gear modifications and their ability to reduce interactions between turtles and the longline fishery, NMFS plans to export the technology to foreign countries that have fisheries in the Pacific ocean that have been recorded to interact with sea turtles.

If NMFS issues the permit as requested in the application, a limited number of commercial longline vessel operators will be recruited by NMFS to conduct research activities, under the direct supervision of NMFS personnel or NMFS' contractors.

The U.S. longline fishery is a small segment of the total amount of longline fishing that occurs in the Pacific Ocean. Conducting fishing experiments on sea turtle take reduction methods may ultimately increase the likelihood of survival and recovery of the sea turtle populations by reducing takes and mortalities in domestic and international longline fisheries and by increasing sea turtle conservation awareness throughout the fishing community.

Fishing vessel operators participating in the experiments will receive training on the experimental protocols and data collection requirements and the terms and conditions of participating in the experiment. The NMFS principal investigators for these experiments will ensure and confirm that the participating vessel operators comprehend the experimental protocols and the terms and conditions under which they will be allowed to operate. There will be a written, signed agreement specifying cooperative participants responsibilities. Failure of vessel operators to comply with experiment protocols or the agreement will result in the termination of their participation in these experiments under the permit. Fishermen must agree to follow these instructions for setting their gear. NMFS observers will oversee the operations and record results.

2.2.1 Experimental Design

A. Gear modification (test use of blue-dyed bait and moving branch line)

Two modifications to fishing practices which have been determined to have promise for reducing turtle takes while having only minor impacts (if any) on fishing performance (target species CPUE) are the use of squid bait dyed blue with food coloring and the removal of branch lines attached to the main line closest to the float line attachment points. Therefore, the first portion of the proposed research would simultaneously test a combination of these two experimental gear modifications as a single experimental fishing treatment against a control. The experiment would test the effect of longlining for swordfish using blue-dyed bait and moving the nearest branchlines to at least 40 fathoms from the nearest floatline and comparing this method to standard (i.e. control) fishing operations. Data analyses and results, in combination with results of a similar study undertaken by NMFS in the Atlantic, would determine the efficacy of the combined method for reducing sea turtle bycatch compared to normal fishing operations. This portion of the experiment will involve the majority of time and effort (3 years) and will also have the most impact to turtles (i.e. higher turtle take than other portions of the experiment).

A limiting condition of the proposed experiment is the need to minimize the take of endangered and threatened sea turtles while retaining the statistical power necessary to detect a significant effect of the bycatch reduction treatment. Turtle takes are rare events in the Hawaii-based fishery and they have the statistical power of a Poisson distribution, in which the standard deviation is as large as the mean. In such circumstances, the statistical power of a controlled experiment depends on the number of turtles taken in control and treatment operations (see attachment 1 to the May 1, 2001, permit application) and not on the number of fishing operations (sets). Therefore, to increase the power of the experimental tests, it is best to use the fishing style with the greatest turtle take rate, which, in the Hawaii-based longline fishery, is swordfish-style fishing. This type of fishing is the best for testing sea turtle take reduction measures because, based on historical data, it will have a higher take rate and will provide more rapid statistical confirmation of bycatch reduction by contrasting control and treatment operations. This is also the type of fishing that has been prohibited by the March 29, 2001, biological opinion for non-research purposes because of the high take rates of sea turtles.

The objective of the experiment will be to test whether a treatment reduces turtle takes versus a control. The experiment will continue until a fixed number of turtles are caught, often referred to as a "sequential" experiment. Because alternating treatments with controls along a single longline will not result in independence between control and treatment if the control sections (e.g. highly visible undyed squid) attract turtles to the adjacent treatment sections, full sets will serve as the experimental unit for testing any treatment that involves the attractiveness of the longline to turtles or to target species. The applicants have assumed that turtle takes come from two distributions (in the statistical, not the biological sense), a treatment group and a control group, and that within each

group, turtle takes at the set level are independent identically distributed Poisson variates.

A power analysis was conducted to scope out a variety of sample sizes required to detect a bycatch method that has different degrees of effectiveness in comparison with the control fishing method (see attachment 1 in the May 1, 2001, permit application). Because leatherback turtles "arguably the species for which results are needed most badly due to the presumed dire status of the population," (see application p. 20) the applicants chose this species to focus on for the experimental design. Take numbers required to detect a 25% effective treatment are much higher than those required to detect a 50% effective treatment because of the lower signal-to-noise ratio when the treatment is closer to the control method (Table 4 in the permit application). The higher the type I (alpha, attachment 1 in the application) and type II (beta, attachment 1 in the application) error rates that can be accepted, the lower the sample sizes required.

The applicants have proposed a one-sided composite test where the null hypothesis is that the treatment reduces turtle takes by 50% or more versus the alternative hypothesis that the treatment reduces turtle takes by less than 50%. Using the highest level of type I and II error rates that the investigators can accept, and anticipating that the treatment will be at least 50% effective in reducing take of leatherbacks, the preferred design will take a total of 36 leatherbacks spread out over 3 years (Table 4). If the treatment is 50% effective, 12 of these turtles will be caught by treatment fishing operations and 24 will be caught by control operations and the results will be statistically significant at the alpha = 0.10 level and beta = 0.20 level . The required take is 12 leatherbacks per year (36 leatherbacks in 3 years), the number given in the summary of designs. Fractional numbers are raised to the nearest whole integer in summarizing annual takes.

Table 4. Sea turtle takes/mortalities per year in minor gear modification experiment, with significant (50% effective*) leatherback findings in 3 years.

				Concomitant takes per year (other species)					
Error Levels		Leatherbacks/year		Loggerheads/year		Olive ridleys/ year		Greens/year	
Alpha	Beta	Takes	Morts	Takes	Morts	Takes	Morts	Takes	Morts
0.10	0.20	12	4	65	24	6	2	4	1

*treatment reduces leatherback take by 50% compared with control

Equal numbers of treatment and control operations (sets) will be conducted but the total number of sets listed is just an estimate based on historical capture rates of turtles by swordfish style fishing gear (leatherbacks - 0.0154/set; loggerheads - 0.0829/set; olive ridley - 0.0078/set; green - 0.0044/set). Again, the statistical properties of Poisson-distributed data are such that the number of sets is not critical to the test, and the experiment will be limited to the number of turtle takes required, not the number of sets estimated. If more sets are needed to reach the required number of observed turtle interactions, additional fishing operations will be contracted. The estimated total number

of sets per year for this portion of the experiment will be 1,039, a third of the 3,117 sets that may be required over three years.

The estimated number of fishing operations required for finding a statistically significant effect of a bycatch reduction measure that is 50% effective for leatherback turtles will have a concomitant take of other turtle species, based on the historical rate of interactions with those species by the type of fishing operations that will be used in the experiment. The requisite number of operations for the preferred leatherback experimental design will probably result in a take of loggerhead turtles (65 per year, Table 4) sufficient at an alpha level of 0.05 and a beta level of 0.10 to find a significant effect of a 50% effective bycatch reduction method in only 1 year (61 per year, Table 5 in the permit application). If the experiment is conducted for the full three-year estimated time period, this take will reach 195 loggerhead turtles which is enough to find a significant effect of a treatment that is only 30% effective at a lower, but acceptable error level. Since this design dovetails so well with the leatherback design it is incorporated in the preferred design for leatherbacks.

B. Testing "stealth gear" and deep-set daytime fishing for CPUE viability

Because of sea turtles' association with floating objects and possible attraction to anomalies in what otherwise is a featureless ocean, the applicant proposes to test the use of "stealth" gear - longline gear that has been camouflaged in order to be less visible to sea turtles. Before determining whether this major gear modification may reduce sea turtle interactions, the applicants first want to ensure that CPUE of target species using these modifications is still comparable to standard longline fishing. Therefore, reducing the visibility of longline gear to sea turtles by using "stealth" longlines with major gear modifications is proposed for testing viability in maintaining target species CPUE in both swordfish-style (shallow set, nighttime) and tuna-style (deep-set, daytime) fishing operations and comparing to standard (i.e. controlled) swordfish- and tuna-style operations. Any information regarding sea turtle interaction rates will be secondary.

The treatment sets will utilize floats that are blue on the bottom and orange on top, and control sets will utilize typical floats that are orange all over. The treatment sets will also use dark grey monofilament for main line, float lines, and branch lines, while the control sets will use typical longline gear (i.e. visible). Battery powered, narrow-frequency, yellow light emitting diode- (LED) based, down-welling (shaded on the upper half) light sticks will be used on stealth gear (treatment), and regular yellow chemical light sticks will be used on standard gear (control). Lastly, for stealth gear (treatment), the metallic shine of the branch line and float line snaps will be removed or they will be painted, and the bait will be dyed blue (described in Boggs (2000)), while controls will use natural (i.e. un-dyed) squid and longline gear used by typical Hawaii-based longline fishers. The applicants have stated that they need at least 3 fishing trips (i.e. 30 sets) with controls for a credible demonstration in both types of fishing operations. Therefore, there will be 30 control sets and 30 treatment sets each for swordfish-style and for tuna-style fishing operations (120 sets total).

Information will be collected on sea turtle bycatch during this portion of the experiment, but because few sets will be needed to determine differences in CPUE, there will not be a sufficient number of sets to determine statistically whether stealth gear reduces sea turtle interactions. Based on the number of sets needed to test CPUE viability, and on historical catch rates of the four species of turtles likely to be encountered by both swordfish-style[1] and tuna-style[2] fishing, the applicants have estimated the number and species taken (and killed) during this portion of the experiment.

Similar testing of target species CPUE is proposed for deep-set daytime swordfish fishing. This proposed method would target swordfish deep, where they descend during the day, using swordfish-type bait and lightsticks in areas where near-surface nighttime swordfish abundance is high. Deep daytime fishing operations for swordfish will use a depth configuration comparable to that of tuna gear, which will be modified based upon results expected within the next few months from swordfish recently tagged with pop-up satellite transmitting archival tags (PSATs). These tags will report the typical daytime depth distribution of swordfish. Target depth will be achieved using a main line shooter and a much greater length of main line and greater number of hooks between floats while maintaining the standard swordfish-style number of branch lines per set. Depth will be measured with time-depth recorders to ensure target depths are achieved. The applicants have stated that 30 sets will be needed to demonstrate target species CPUE viability.

Information will be collected on sea turtle bycatch during this portion of the experiment, but because few sets will be needed to determine CPUE viability, there will not be a sufficient number of sets to determine statistically whether deep set daytime fishing for swordfish reduces sea turtle interactions. Based on the number of sets needed to test CPUE viability, and on historical catch rates of the four species of turtles likely to be encountered by swordfish-style fishing, the applicants have estimated the number and species taken (and killed) during this portion of the experiment. These take levels have been combined with the estimates for the "stealth" gear experiment and are presented in Table 5.

Every effort would be made to avoid taking any turtles in the stealth and deep swordfish fishing tests for target species CPUE. This will be accomplished by trying to schedule direct experimental fishing effort to times and areas where the target fish species CPUE was historically high and the turtle take rates were low. No sea turtle takes are needed for initial tests of these methods, which are intended to demonstrate CPUE, although some

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[1]Applicants have used the following sea turtle interaction rate based on historical takes in the Hawaii-based longline fishery using swordfish-style fishing: 0.0044 greens/set; 0.0154 leatherbacks/set; 0.0829 loggerheads/set; and 0.0078 olive ridleys/set.

[2]Applicants have used the following sea turtle interaction rate based on historical takes in the Hawaii-based longline fishery using tuna-style fishing: 0.0025 greens/set; 0.0055 leatherbacks/set; 0 loggerheads/set; and 0.0153 olive ridleys/set

loggerheads, a few leatherbacks, olive ridleys, and green turtle takes are anticipated, based on historical interaction rates in the Hawaii-based longline fishery.

The stealth and deep day swordfish experiments will be conducted at the same time, and in the same area, with three vessels: one conducting control operations to demonstrate high near-surface abundance of target species, another conducting stealth tests, and the third conducting deep daytime fishing for swordfish. Thus there will be some economizing of the control operations to serve two purposes. In testing the stealth gear with tuna style fishing there will be only two vessels, as both stealth and control fishing operations will be conducted deep during the day. The vessels would fish south of the Hawaiian Islands, in areas currently open to Hawaii-based tuna fishing operations. This portion of the experiment is estimated to last no longer than one year. In addition, with a low number of sets, these experiments are expected to have low levels of sea turtle take.

Table 5. Stealth gear and deep daytime swordfishing tests to demonstrate CPUE viability

Number of sets			Synoptic Vessels	Total Turtle Takes/Mortalities (one year experiment)							
Control	Stealth	Deep Day		Leatherback		Loggerhead		Olive ridley		Green	
60	60	30	3	2	1	8	3	2	1	1	1

C. Testing use of hook timers and hook type

Measuring trends in the time and depth of sea turtle captures could reveal particular time intervals or depths of longline operations for which sea turtles are most vulnerable, revealing possible modifications to fishing operations for future testing. The use of hook timers, in conjunction with time-depth recorders (Boggs, 1992) is proposed for this purpose. Hook timer experiments will be conducted using standard swordfish style gear fitted with hook timers as described by Boggs (1992). No controls are used, and the comparison is between different times and depths within the combined fishing operations. Based on research conducted on fish (Boggs, 1992), the applicants anticipate that 30 hook timer readers (i.e. 30 observations of a sea turtle species taken by longline) are needed in order to detect trends in turtle capture time or depth. Based on historical take levels in the swordfish fishery, the applicants anticipate that two years are needed for this portion of the experiment.

The testing of large (18/0) circle hooks for the viability of target species CPUE is proposed as a piggyback project during the hook timer measurements. Therefore, this experiment will utilize alternating "J" and 18/0 circle hooks on all hook timer operations. The applicants anticipate that this portion of the experiment will only require one year to demonstrate credible results. Experiments comparing 16/0 circle and J hooks in the Azores (Bolton and Bjorndal, 1999) and in the North Pacific (LaGrange, 2001) reduced the severity of injury of a hooked turtle; however the target species CPUE was reduced the by 30-50%. Both Bolton (personal communication) and LaGrange (personal

communication) have suggested that larger (18/0) circle hooks could increase the viability of target species CPUE. Therefore testing larger circle hooks is proposed for this purpose. Because testing of different hook types differs only in their mechanical effects after a target species (or turtle, in the hook timer portion of the experiment) interacts with the hook, treatment and controls can be applied independently on the same set without pseudo-replication. If the 18/0 circle hooks are as effective at catching target species as the standard J hook, then the implementation of this gear modification in longline fisheries may reduce the severity of sea turtle injuries, thereby increasing post-release survivability.

Table 6 shows the number of sets anticipated per year to detect trends in loggerhead capture time or depth. Loggerheads have been chosen since, based on historical capture records, this is the species most likely to interact with the swordfish fishery north of the Hawaiian Islands. Other sea turtle species will be taken concomitantly with loggerheads, as shown in the table.

Table 6. Hook timer and hook type experiments, estimated effort, turtle take/mortality per year.

Total Years	Sets / year	# Full-time vessels	Loggerheads/yr		Leatherbacks/yr		Olive ridleys/yr		Greens/yr	
			Takes	Morts	Takes	Morts	Takes	Morts	Takes	Morts
2	181	2	15	6	3	1	2	1	1	1

Handling and research activities other than capture will be covered by permit #1190 issued to NMFS-Southwest Region on March 8, 1999. Permit #1190 and its modifications have qualified for categorical exclusion under the NOAA NEPA regulations and policies (NOAA Administrative Order 216-6 Environmental Review Procedures). However, since permit#1303 relies on permit #1190 for authorization to conduct sampling and other research activities, the effects of the activities authorized under permit #1190 are included here for clarification.

2.2.2 Turtle Handling Procedures

NMFS observers, technicians, fishing captains and crews will receive training on handling procedures for turtles encountered during the experiments under this permit. Training will be conducted by qualified NMFS personnel. Training will follow the guidelines and recommendations in Balazs *et.al.* (1995) and NMFS (2001: Manual for Sea Turtle Life History Form) and modified procedures using line and hook cutting and de-hooking devices (Anon, 2001b) being developed by NMFS. All vessels participating in these experiments will be equipped with dip nets, line and hook cutters, and de-hooking devices and training provided in the recommended procedures for using these devices to reduce post hooking or entanglement injury and mortality. A laminated instruction card will be provided to each observer and vessel to be prominently displayed near the gear hauling station for instant reference.

Captains, crews, and observers will be required to scan main line as far ahead as possible during gear retrieval to sight turtles in advance and not get ahead of the main line while retrieving gear. Upon sighting a turtle the vessel and main line reel speed will be slowed and the vessel direction will be adjusted to move toward the turtle to minimize tension on main line and branch line with turtle. When the snap of the branch line is in hand, the vessel will continue to move toward the turtle at a speed as slow as possible, if not possible vessel will stop with engine out of gear and turtle will be brought along side the vessel. Branch line will be retrieved slowly keeping a gentle consistent tension on the line. Slack will be maintained on the branch line to keep the turtle near the vessel and in the water.

Once the turtle is alongside the vessel the observer will assess the turtle condition and size and determine if it is hooked or entangled and if hooked whether the hook is ingested or external. If the turtle is small enough, and if conditions are such that it can be safely brought aboard the vessel, the observer will use a dip net (that meets standards specified in NMFS regulations) to carefully bring the turtle aboard by placing the net under the turtle and safely lifting it out of the water and onto the deck. If the turtle is determined to be too large to safely board without causing further injury to the turtle, or if conditions are such that the turtle cannot be safely brought aboard, then the turtle will be identified and photographed and, if possible, a tissue biopsy will be obtained using a 10 ft pole with a biopsy coring device attached to the end. The coring device is a sharp-edged, circular metal device about 6 mm in diameter with 3-4 teeth inside that point inward so as to trap the sample. Using this device the observer will target the shoulder region or carapace (leatherbacks) of the animal. Observers will be instructed to avoid trying to gather biopsies from the head region to avoid serous injury to the animal.

Line and/or hook cutters or de-hookers will be used to remove longline gear. If not hooked internally the hook will be removed using NMFS developed and approved de-hooking device. If the hook cannot be removed without causing further injury to the turtle, a hook-cutting device developed and approved by NMFS will be used to cut the exposed hook. If the turtle is hooked internally or in the mouth, the leader and any portion of the hook exposed will be cut using the line and /or hook cutting device as close to the turtle as possible without causing further injury. Line cutters will be used to clip and remove line to release the turtle; no line will be left attached to turtle if possible. When releasing a turtle the vessel shall be in neutral and the turtle eased into the water and observed to be safely out of the way before engaging the vessel propeller.

The condition of turtles brought aboard the vessel will be assessed by the observer. Turtles that appear comatose will be placed in a shaded, protected area covered with a moist cloth with the head in a down position. The hindquarter will be elevated several inches, and resuscitation attempted. The turtle will be checked periodically for up to 24 hours; the observer will touch the eye and pinch the tail periodically to see if there is any response. If there is no response after 24 hours, the turtle will be judged dead. The observer will leave any entangled line or hook in place and cut the line leaving about 2 feet of line remaining and tape it to the turtle. The observer will then collect standard life

history data (see below) and write collection identification information on tag, attach tag securely to turtle and store turtle in a plastic bag on ice or in a freezer. Turtles successfully resuscitated will be treated as active turtles (see below).

If the turtle is alive then it is placed in a safe cool dry place out of direct sunlight away from the fishing activity. Animals that cannot be kept out of direct sunlight are covered with wet towels or carpeting in a safe place. The animal's movements are restricted by penning it up in a make-shift fashion using available resources, or the animal is turned on its back and supported with towels or carpeting to prevent rolling. Again, this is done to keep the animal safe. The observer records the date, time, set number, trip number, and position of incidental capture of the sea turtle and waits until the end of gear retrieval activities when the turtle can be further processed for data, tagged, and released. After gear retrieval activities have ceased, scute counts used in identification are done. Observers then take straight and curvilinear measurements of carapace length and width. Additional measurements taken are of the plastron and tail. All measurement are obtained with a set of two meter calipers and a measuring tape. The observer also notes abnormalities and epibiota associated with the specimen. After scute counts and measurements are taken biopsies used in DNA analysis are gathered.

Tagging - Inconnel nickel alloy tags are attached to each fore-flipper with a specifically designed applicator. The alloy tags are placed near the origin of the first large scale on the trailing edge of the fore-flipper leaving enough room for growth. If there are tags present prior to capture, the information from the tags is recorded. Previously present tags that are unreadable or not secure are removed and replaced.

The turtles will be scanned to determine if they have been previously tagged with a Passive Integrated Transponders (PIT) tags. If they have not, a PIT tag will be placed in the left front flipper of all turtles without PIT tags.

Tissue Sampling - Tissue samples will be taken on all turtles by a biopsy punch (6 mm) of the trailing edge of the rear flipper per standard protocol and preserved in a supersaturated salt DMSO solution. Turtles will be placed on their back and the trailing edge of the rear flipper swabbed with betadine. Placing the flipper against the plastron, the observer will press the biopsy punch firmly into the flesh as close to the posterior edge of the flipper as possible, cutting all the way through the flipper. A wooden skewer will be used to remove the tissue plug and it will be stored in labeled vials of preservative. To prevent infection, the area biopsied will be swabbed with betadine.

Satellite Transmitter Attachment - Satellite transmitters are attached to up to 50 hardshelled turtles over 45 cm in carapace straight length. These devices provide information on temporal-spatial movements, water temperature and depth of dives. Transmitters are placed on the carapace on second or third vertebral scute for optimum transmission during periods when the animal is surfaced. Two different types of transmitters will be used in this research: conventional tags and Pop-Up Satellite tags (PSATs). Each type of tag has a different attachment procedure.

Conventional Tags - For this project the proposed method of transmitter attachment will employ a towed, hydrodynamic transmitter package that trails passively behind the turtle on a short, flexible lanyard. This method is preferred because of the minimal handling time, and minimal stress to the turtle on the deck of a boat, along with the greatly reduced drag of the transmitter in this configuration, as compared to other common attachment techniques that stick the transmitter on the high point of the turtle's shell. The lanyard will be no more than 2/3 the length of the carapace, precluding entanglement with the flippers or any part of the turtles body. The trailing transmitter package is designed with two sets of breakaway systems: an in-line breakaway link, which prevents any problems for the turtle from potential entanglement of the transmitter; and 3 separate in-line corrodible links that eliminate the possibility of long-term encumbrance by dissolving steadily in salt water. The breakaway link is strong enough to hold the transmitter as it trails in the wake of the turtle, but weak enough that it pulls apart if the transmitter were to become entangled in fishing gear or other unforeseen manner. The corrodible links, made of brass, begin to disintegrate after approximately 1 year in seawater, leaving nothing attached to the turtle. The intervening lanyard will be 1 mm monofilament line, which will provide flexibility and better performance of the transmitter. The trailing hydrodynamic transmitters are all painted dull black to render them cryptic to other animals.

After a turtle is brought onboard the vessel, all handling for measuring, tagging and tissue sampling will be completed. After completion of these activities, the transmitter along with the lanyard, which will be fully assembled, will be attached simply and quickly using techniques well-established for juvenile loggerhead and Kemp's ridley turtles. First, one of the posterior-most marginal scutes along the midline of the carapace will be cleaned lightly with a clean towel, then cleansed with a Betadine wipe to prevent infection. At a position approximately 10 mm from the rear edge of the shell, a single 3 mm hole will be drilled through the carapace where it overhangs the rear of the turtle. This process takes from 1 to 2 seconds, and does not elicit a response from the turtle. For each turtle, a new drill bit will be used, and the bit will be in disinfectant until the time of its use. In addition, Betadine will be applied to the small hole as a general disinfectant afterward. Next the end of the lanyard will be threaded through the small hole, and the length will be adjusted according to the guideline of not longer than 2/3 the turtle's carapace length. Finally, the lanyard will be attached using a corrodible crimp, that will corrode in saltwater, thus allowing the turtle to shed the entire transmitter package at the end of the study. The entire process, at an unhurried pace, takes approximately 4 minutes, after which the turtle will be released back into the water.

PSATs - Attachment of the PSAT tag base (Wildlife Computer tags weigh less than 60 g) to the carapace will be via either fiberglass resin per above or by epoxy, the latter a technique being developed and tested by the SWFSC(Anon. 2001c). The procedures developed by the SWFSC use Marine Fix ® Fast (MFF) epoxy to attach a baseplate on a dry carapace on clean flat scutes toward the back of the turtle. The epoxy is mixed according to manufacturer's instructions and applied to the base plate of the satellite attachment system. The base plate is then pressed down firmly against the carapace for a few minutes to squeeze out any air pockets. Excess epoxy on the sides of the base plate are

smoothed out with a wet gloved fingertip. The epoxy hardened completely in 30 minutes. The PSAT tag is then attached to the base plate using a short lanyard attachment. The turtles will be released following procedures detailed above.

Disentanglement - The observer attempts to remove hooks and as much entangling gear from the animal as possible without causing further serious injury to the turtle. Hooks are removed using decoking and line cutting devices pliers usually supplied by the vessel and bolt cutters supplied by NMFS. In those cases where hooks are deeply ingested and cannot be removed as much of the leader and hook are removed as possible. When the above are complete the turtle is ready for release back into the wild.

Release - The observer notifies the captain to come to a complete stop. When the vessel is stopped and out of gear the turtle is released by gently by sliding the animal head first through the boarding door of the vessel. The observer records the date, time, position, swimming behavior, and direction.

All biopsy samples will be analyzed by the National Sea Turtle Genetics Lab at the Southwest Fisheries Science Center (SWFSC) in La Jolla, California. All satellite tag data will be analyzed by the SWFSC - Honolulu and La Jolla, CA laboratories. Flipper and PIT tag release and recapture data will be archived with the Cooperative Marine Turtle Tagging Program maintained by the Archie Carr Center for Sea Turtle Research at the University of Florida. Necrosis on carcasses returned to shore will be done by qualified personnel at either the SWFSC. During necropsy, samples will be taken for life history studies: humeri for ageing, etc. All data will be recorded on forms specially developed to record the details of this experiment, and will be analyzed by the SWFSC or its contractors.

Transport back to shore for rehabilitation - The applicants propose to transport deeply hooked (defined as hook ingested past the mouth cavity - in esophagus or deeper) hard-shelled turtles taken in the experiments back to holding facilities for treatment and monitoring of hook progression. Permitting the development of treatments and rehabilitations for hooked turtles will also provide an opportunity to better understand the mode of injury and prognosis for recovery of deeply hooked turtles (i.e. mortality rate). Only hard shelled sea turtles of less than 70 cm straight carapace length will be transported, and only if they are captured within an estimated 72 hours return time to Honolulu.

Based on the raw observer data for sea turtles caught by shallow set swordfish and mixed target longline sets, the percentage of turtle species that are deeply hooked and alive, and caught within 72 hours of Honolulu (at a vessel speed of 8 knots) are: about 7% for loggerhead turtles, 53% for olive ridley turtles, and 20% for green turtles. The data on all turtle takes that have been measured by observers indicates that about 82% of loggerheads, 100% of olive ridleys, and 87% of greens are under 70 cm straight carapace length (attachment 4 in permit application). These percentages and the estimated number of turtles which may be taken in the experiments were used to estimate the number of turtles

which might be transported to Honolulu (Table II-6). These estimates are likely to be higher than the number actually transported as the vessel may not always be prepared to depart immediately for Honolulu from the capture location. However, if more turtles of the appropriate size or condition for transport happen to be captured, the applicants state that there is no reason why they also should not also be returned to port, and therefore, the numbers in Table 7 are not intended to be a limit. The upper limit will be the total annual take shown in Table 2.

Table 7. Estimated annual number of deeply hooked but alive hard-shelled turtles less than 70 cm straight carapace length captured during the experiments within 72 hours of Honolulu that could be transported to Honolulu for treatment and monitoring of hook progression.

Species	Annual Estimated Turtles Transported		
	Year 1	Year 2	Year 3
Green	1	1	1
Loggerhead	5	5	4
Olive Ridley	5	4	3

2.2.3 Transportation of a Listed Species

a. The NMFS Honolulu Laboratory has been transporting injured and diseased turtles for many years as part of the Sea Turtle Stranding Network. Transportation from vessels to the veterinary clinic on Oahu by motor vehicle will follow the same procedure used in the Stranding Program to transport injured or diseased turtles on Oahu. Transportation at sea will be provided by captains of fishing vessels participating in the research under the supervision of on-board fishery observers, fishery biologists, or biological technicians.

b. Turtles must be caught within an estimated 72 hours from the port of Honolulu and will be brought to port within 8 hours of this estimated time or else they will be released at sea. The Protocol for Sea Turtle Stranding Response (attachment 5 in the permit application) calls for turtle transportation 24 hours a day 7 days a week with a typical response time of a few hours for remote Oahu locations during weekends and after hours. With the advantage of real time reporting from participating vessels and with a veterinarian contracted specifically for this project it should take no more than an hour to transport the turtles from the vessel to the veterinarian. Depending on the turtles condition and any necessary surgery or other treatment turtles will be kept at the clinic for as long as necessary and then be moved again to NMFS holding facility at Kewalo Basin. Turtles which appear to be rehabilitated will be released to the wild (1c, below) and some turtles may be euthanized when necessary in the opinion of the attending veterinarian (Section 3, below)

c. Turtles which eliminate hooks or have had them removed by surgery or other means developed by the veterinary work in this project, and which appear to be fully recovered

may be transported back to a vessel and taken to sea for release within a 72 hour radius of Honolulu.

d. Turtles will be transported at sea and in Honolulu using Petmate Vari Kennels, giant size (48 inches long x 32 inches wide x 35 inches high) which will be supplied to each vessel participating in the research. These kennels are wide enough for the largest turtles that will be transported (70 cm straight carapace length = 28 inches).

e. Captured deeply-hooked turtles that will be returned to Honolulu will be handled according to the guidelines developed in NMFS workshops (*see* Guidelines for Handling Marine Turtles Hooked or Entangled in the Hawaii Long line Fishery, Balazs *et al.*, 1995). These include specified procedures for how to haul the main line, retrieve branch lines which catch turtles, assess turtle condition and hook location, removing lines, resuscitation, and care of turtles on board the vessel. The procedures are those mandated for use by all Hawaii-based longline captains and crew by court order and/or reasonable and prudent measures or conservation measures stated in relevant biological opinions, to de-hook and disentangle, and resuscitate turtles, as appropriate and possible. In this study the field supervisor (fishery observer, fishery biologist, or biological technician) will oversee or conduct these procedures, and instead of returning a recovering deeply-hooked turtle to the sea after 24 hours, the turtle will be retained on board, covered in a moist cloth in the pet carrier in a shaded area for the 72 hour transit period to Honolulu.

Treatment by the veterinarian in Honolulu will include all measures possible at a fully equipped clinical facility including x-rays, surgery, anesthetics, antibiotics, etc. as deemed best by the project veterinarian (to be named). The veterinarian contracted for the project will have a minimum of 5 years experience in the first hand assessment and treatment of injured and diseased sea turtles and will operate from a clinic provided with complete veterinary instrumentation required to treat injured and diseased sea turtles. When a turtle's condition has stabilized and/or all treatments which may improve its chances for survival have been carried out, it will be moved to NMFS holding facility at Kewalo Basin. If the turtle is to be returned to the sea for release, the release procedure will again be as specified in the "Guidelines for Handling Marine Turtles Hooked or Entangled in the Hawaii Long line Fishery" (Balazs et al., 1995).

2.2.4 Holding of a Listed Species

a. Dimensions of pools used to hold sea turtles at NMFS Kewalo Facility and water supply:

2 fiberglass tanks, 2 m diameter, 1 m deep, 20 gal/h, 2 turtles/tank maximum.

2 fiberglass tanks, 2 m diameter, 1.5 m deep, 20 gal/h, 2 turtles/tank maximum

3 fiberglass tanks, 7 m diameter 2 m deep, 200-300 gal/h, 10 turtles/tank maximum

Turtles will be less than 70 cm straight carapace length, of both sexes, and unknown age. Within these broad categories, the size and species of individuals held at any given time will vary and cannot be predicted since incidental captures are involved. The maximum number of turtles per tank listed above is based on assuming a 70 cm carapace length, whereas a larger number of smaller turtles could be kept. Assuming 70 cm carapace length, the capacity of the 7 tanks is 38 turtles. The total number and mix of species may be as estimated in Table 2, with a maximum of 11 turtles in the first year, but it would be extremely unlikely that such numbers of turtles would need to be held at one time. Delayed mortality of the deeply hooked turtles is assumed in the Western Pelagics FMP biological opinion (NMFS, 2001) to be 42% so it would be unlikely that even the total annual numbers estimated to be transported (8 to 11 turtles) would ever need to be maintained at one time.

b. Water quality. Water supply is from a filtered sea water well, no temperature control is needed since ambient temperature is maintained at 25 ± 1°C. Oxygen levels are irrelevant as turtles are air breathers.

c. Frozen squid (*Loligo*), and or herring (*Clupea*) packed for human consumption, is maintained frozen until day of use, then thawed and fed to turtles once a day *add libitum* (Protocol for care and feeding of Kewalo turtles, attachment 6 in the permit application). Depending on appetite and size feeding turtles are fed 1-15 squid or fish weighing around 100 grams apiece per day.

d. Sanitation practices include regular tank cleaning and quarantine of diseased turtles (Protocol for care and feeding of Kewalo turtles, attachment 6 in the permit application). Green sea turtles affected by fibropapilloma tumors are held in separate tanks, fed and cared for after non-tumored turtles have been fed and cared for, and are cleaned with separate brushes. Tanks and brushes used with tumored turtles are disinfected prior to use with non-tumored turtles.

2.2.5 Emergency contingencies

Euthanasia will be used when necessary according to the procedure given under University of Hawaii - Institutional Animal Care permits (attachment 7 in the permit application).

NMFS Kewalo Facility has a second sea water well with its own pump as a backup to the primary seawater supply. The facility also has an automated alarm system that notifies key personnel in case of fire or power failure. Emergency power generation and saltwater pumping equipment is available.

D. Annual Evaluation and Reauthorization

Permit #1303 is proposed to be issued for up to three years. However under specified circumstances the permit's authority will be withdrawn and the experiment terminated. At the end of the first year of the experiment, an evaluation of all results, including the results

of a risk assessment to determine the costs and benefits of revising the experimental design to incorporate newly discovered or developed take reduction measures, will occur in consultation with the Office of Protected Resources. Currently, the first evaluation is expected to occur in June or July of 2002. During this evaluation, the applicants will determine whether the modifications to longline gear successfully reduced loggerhead interactions by 50%. The applicants have stated that they would be able to determine success for loggerheads within the first year due to the high interaction rates loggerheads have had with swordfish sets and the number of sets needed to obtain first-year results for leatherback interactions. If the applicants determine that the experiment has not successfully reduced interactions with loggerheads by 50%, they may re-evaluate their experiment and, based on the results of other lab or field experiments, request a modification to their permit. If no other information is available, the experiment will cease in order to avoid unnecessary takes of turtles. This Opinion will evaluate the effects of issuing a 3-year permit for the experiment as it is currently proposed. However, any takes that are anticipated for a modified experiment to be approved by OPR will not exceed anticipated takes for this initial proposal.

If after one year the applicants show that minor gear modifications have had a 50% or greater reduction in loggerhead interactions, the Office of Protected Resources will evaluate whether or not the experiment should continue another year in order to evaluate success for leatherbacks. Their determination will be based on: 1) the status of loggerheads; and 2) initial results with leatherbacks during the first year of testing. Continuing the experiments for another 2 years in order to prove effectiveness for leatherbacks might unnecessarily affect loggerheads after the point when the effectiveness of a measure has been determined for these species. Therefore, it is important to re-evaluate the status of loggerhead populations in order to determine whether or not they can withstand additional takes and possible mortalities. It is also important to determine whether results from the first year of testing show any positive results for leatherbacks.

If the initial results are anywhere within a fairly broad range, they might still average out to show 50% effectiveness after the full three year experiment due to the very high variance in turtle take rate. Therefore statistical analyses conducted at an interim point in the experiment will have to indicate a very unsuccessful preliminary result (e.g. bycatch increase using the modified gear) to be almost certain that a continued experiment would not eventually show 50% successful bycatch reduction at acceptable confidence levels. A lack of interim positive results will have to be detected at a very high probability (e.g. $p< 0.05$) to be conclusive. For example, assuming Poisson distributed data, after 12 leatherback turtle takes the distribution would have to be 5 in the control treatment and 7 in the modified gear treatment to conclude with 95% confidence that the treatment was not having a 50% reducing effect on bycatch.

Without conclusive findings that the results are negative, and in the absence of other considerations, the leatherback experiment would continue in order to reach significant conclusions within the general levels of statistical confidence selected in the original power analysis. Also, interim testing will alter the power analysis. All tests and

probabilities after the first year will have to be re-derived conditional on the experiment continuing to the year of interest.

If the Office of Protected Resources determines that the modified gear experiments show initial success with leatherbacks and that loggerhead status has not declined, the experiment will continue for a second year. If the status of loggerheads has declined below the status of the species reviewed in this opinion (e.g. if additional information indicates new threats, higher rates of decline, or a worsening population structure), NMFS must either take measures to improve the baseline such that positive benefits will offset the negative consequences of the experiment, or the experiment must be discontinued. If the experiment does not show initial success for leatherbacks, the applicants will need to re-evaluate potential changes to the experiment (e.g. use of stealth gear, deep daytime sets, use of 18/0 circle hooks) that might prove successful for reducing leatherback interactions before continuing with the experiment. If the Office of Protected Resources determines that one year of modified gear experiments have not shown success for leatherbacks and the status of loggerheads is worse than anticipated in the Opinion (i.e. baseline conditions have worsened), then methods will have to be revised and improvements to the baseline of loggerheads will have to be implemented if the experiments are to continue.

If the experiments continue for a second year, another risk assessment and evaluation as described above will take place after the second year before the final year of experiments can proceed.

2.3 Description of Alternative 3 - Issue the permit based on a high confidence sampling for the minor gear modification (test use of blue-dyed bait and moving branch line)

Under this alternative all of the methodologies would remain the same as described in the Proposed Action (Alternative 2) except the minor gear modification (test use of blue-dyed bait and moving branch line) sampling level will be more consistent with conventional experimental design. Scientific experiments typically test hypotheses using a type I error rate (alpha level) of 0.01 to 0.05, to achieve results with 99 to 95% confidence. It is conventional to accept higher type II (beta) error levels (e.g. 0.05 to 0.10). Alternative 3 would simultaneously test the combined use of squid bait dyed blue with food coloring and the removal of branch lines attached to the main line closest to the float line attachment points in swordfish-style fishing against a control as described in the Proposed Action (Alternative 2). Again, the objective will be to test whether the treatment reduces turtle takes versus a control, based on the fixed number of leatherback turtle takes expected for Poisson-distributed variates as required to detect a 50% effective treatment with a conventional alpha level of 0.05 and a beta level of 0.10. This would decrease the probability of making an erroneous conclusion about the effectiveness of the treatments. This alternative design would take a total of 63 leatherbacks spread out over 3 years (see Table 5 for comparison of takes between the Proposed Action (Alternative 2) and Alternative 3). If the treatment is 50% effective, 21 of these turtles would be caught by treatment fishing operations and 42 would be caught by control operations. The estimated number of fishing operations required for this alternative would have a concomitant take

of other turtle species (Table 5), based on the historical rate of interactions with those species by the type of fishing operations that will be used in the experiment.

The take levels required by this alternative are much higher than for the Proposed Action (Alternative 2), because the lower type I (alpha, attachment 1 in the application) and type II (beta, attachment 1 in the application) error rates require larger sample sizes. A power analysis was conducted to scope out a variety of sample sizes required to detect a bycatch method that has different degrees of effectiveness in comparison with the control fishing method at different error levels (see attachment 1 in the May 5, 2001, permit application). A large range of additional alternatives were evaluated in the application, including experimental designs to test for 25% effective bycatch reduction methods. Take numbers required to detect a 25% effective treatment are much higher than those required to detect 50% effective treatments because of the lower signal-to-noise ratio when the treatment is closer to the control method (Table 4 in the permit application).

This alternative would call for an estimated 880 control sets and 880 treatment sets per year for three years (total of 5,281 sets. However, the total number of estimated sets is just an estimate based on historical capture rates of turtles by swordfish style fishing gear. Again, the statistical properties of Poisson-distributed data are such that the number of sets is not critical to the test, and the experiment will be limited to the number of turtle takes required, not the number of sets estimated. The cost of contracting this number of sets would be about 70% greater than for the minor gear modification (blue bait and moved branch line) portion of the Proposed Action (Alternative 2). In order to achieve the higher confidence in sampling, the number of leatherbacks taken would increase by 75% (27/36) in the minor gear modification portion of the experiment and by about 35% (27/44) overall between the two alternatives. Given the critical status of the leatherback population in the Pacific, the decrease in the level of error must be balanced by the increased sample size. The alpha and beta levels of 0.10 and 0.20 described in the Proposed Action (Alternative 2) are sufficient for identifying the most likely measures that would be effective at reducing sea turtle interactions in longline gear.

Table 5. Sea turtle takes/mortalities per year in minor gear modification experiment, with significant (50% effective*) leatherback findings in 3 years. Mortalities are included in the takes.

						Concomitant takes per year (other species)					
	Error Levels		Sets/ year	Leatherbacks/ year		Loggerheads/ year		Olive ridleys/ year		Greens/year	
	Alpha	Beta		Takes	Morts	Takes	Morts	Takes	Morts	Takes	Morts
Proposed Action (2)	0.10	0.20	1,039	12	4	65	24	6	2	4	1
This Alternative (3)	0.05	0.10	1,760	21	7	110	40	11	4	6	2

*treatment reduces leatherback take by 50% compared with control

2.4 Description of Alternative 4- Issue the permit based on a one-year design

Under this alternative the methodologies described in the Proposed Action (Alternative 2) would remain the same except for the minor gear modification (2.2 A) would be based on a one-year sampling for loggerheads and the hook timer and hook type (2.2 C) components would be eliminated . This alternative is based on historical bycatch data indicating that the likelihood of taking a loggerhead is much greater than encountering a leatherback. Given the higher capture rate, a loggerhead experiment can be conducted for one year at an alpha and beta level of 0.05 and 0.10, respectively. The sampling would yield enough data to analyze significance of the treatments for loggerheads assuming a 50% effective fishing method (Table 6 below; Table 5 in the permit application). The expected leatherback takes would not be sufficient to analyze significance of the treatments for this species. Under this alternative the hook timer and piggyback hook experiments would not be conducted. Based on research conducted on fish (Boggs, 1992), the applicants anticipate that 30 hook timer readers (i.e. 30 observations of a sea turtle species taken by longline) are needed in order to detect trends in turtle capture time or depth. Based on historical take levels in the swordfish fishery, the applicants anticipate that two years are needed for this portion of the experimen using 2 full-time vessels. It would be impossible to equip more vessels with hook timers in the available time (the manufacturing capacity for these custom-built instruments has been fully contracted through March 2002).

This is not the preferred alternative because the leatherback is the species of greatest concern. Under this alternative, the minor gear modification (blue-dyed bait and move branch line) could not be analyzed for significance in reducing leatherback interactions due to the insufficient sampling. In addition, the hook timer and hook type testing would not be conducted. This alternative would unnecessarily delay testing to reduce leatherback takes.

Table 6. Sea turtle takes/mortalities per year in minor gear modification experiment, with significant (50% effective*) loggerhead findings in 1 year. Mortalities are included in the takes.

					Concomitant takes (other species)					
Error Levels		Sets	Loggerheads		Leatherbacks		Olive ridleys		Greens	
Alpha	Beta		Takes	Morts	Takes	Morts	Takes	Morts	Takes	Morts
0.05	0.10	981	61	22	12	4	6	2	4	1

*treatment reduces leatherback take by 50% compared with control

2.5 Description of Alternative 5 - Issue the permit without the stealth gear and deep-set daytime fishing CPUE

Under this alternative all of the permit methodologies described in the Proposed Alternative 2 would be included except for the testing "stealth gear" and deep-set daytime fishing for CPUE viability (2.2 B). This alternative is not the preferred because testing major gear modifications for target species CPUE is a critical first step in determining the feasibility of implementing these modifications in the fishery. Modifications to gear or fishing practices that result in extremely low catch of the intended target species likely would not be used by the industry. The loss in revenue from the decrease in catch may not cover the cost of the operation. Tests conducted on the efficacy of stealth fishing gear and daytime deep sets to reduce sea turtle interactions without first determining target species CPUE would result in unnecessary turtle takes. Eliminating the stealth fishing gear and deep-set daytime for target CPUE would delay testing for these potential turtle bycatch reduction methods. These potential methods are our best hope for reducing bycatch if the minor gear modification experiments are determined not to be effective after the first year of the experiment.

3.0 Affected Environment

3.1 Introduction

The affected environment is the Pacific Ocean for swordfish and tuna managed under the PFMP.

3.2 Physical Resource Issues

The physical environment of the Pacific ocean north of Hawaii is oceanic and pelagic in nature. The affected environment is all the areas that will be affected directly or indirectly by the domestic Hawai'i-based longline fishery for swordfish and tuna managed under the Pelagics Fishery Management Plan. The Hawai'i longline fishery operates inside and outside of the main Hawaiian islands' and Northwestern Hawaiian Islands' EEZ (see Figure 1). Hawai'i-based longline vessels vary their fishing grounds depending on their target species. Most effort is to the north and south of the Hawaiian Islands between latitudes 5 ^{o} and 40 ^{o} N and longitudes 140 ^{o} and 180 ^{o} W. Figure 2 shows the maximum historical boundaries of the Hawai'i-based longline fishery using 5 ^{o} increments. A